Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	0	05-290229	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 18:59
L2	2	"05290229"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 18:59
L3	0	07-142022	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:00
L4	2	"07142022"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:00
L5	6	(ishitani near1 toru) and (hirose near1 hiroshi) and (arima near1 yoshio)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:13
L6	26	(shichi near1 hiroyasu) and (tamura near1 hifumi)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:21
L7	3213	(ion adj detector)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:31
L8	1027	l7 and (mesh or screen or grid)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:36

L9	95	l8 and (mcp or ion-to-electron or (ion adj to adj electron) or (multichannel adj plate) or (multi-channel adj plate))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:36
L10	21	l9 and (scintillator or scintillat$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:37
L11	9	l10 and ((voltage or potential) with (mesh or grid or screen))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:37
L12	12	l10 not l11	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:26
L13	3734	(ion near1 detector)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:35
L14	1187	l13 and (mesh or screen or grid)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:31
L15	105	l14 and (mcp or ion-to-electron or (ion adj to adj electron) or (multichannel adj plate) or (multi-channel adj plate))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:31
L16	23	l15 and (scintillator or scintillat$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:31

L17	2	l16 not l10	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:31
L18	10111	(ion near1 detect$4)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:36
L19	2654	l18 and (mesh or screen or grid)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:36
L20	143	l19 and (mcp or ion-to-electron or (ion adj to adj electron) or (multichannel adj plate) or (multi-channel adj plate))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:36
L21	98	"l21" and (scintillator or scintillat$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 19:37
L22	6	l21 and ((voltage or potential) with (mesh or grid or screen))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 20:05
L23	0	l21 and (sp near detector)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 20:05

PATENT ABSTRACTS OF JAPAN

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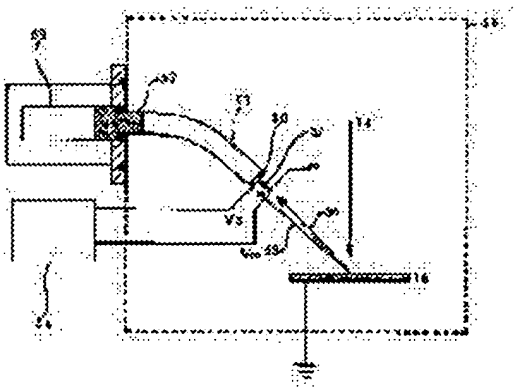
(71)Applicant : HITACHI LTD

(72)Inventor : ISHITANI TORU
HIROSE HIROSHI
ARIMA YOSHIO

(54) CONVERGING ION BEAM DEVICE AND CHARGED PARTICLE DETECTOR

(57)Abstract:

PURPOSE: To perform various works of fine elements with high accuracy at low cost by detecting selectively secondary electrons and secondary ions (positive ion) by controlling impressed electric potential on a mesh from a control electric power supply part.



CONSTITUTION: In a secondary electron detecting mode, emission secondary electrons 55 from a sample board 16 are collected to a mesh 49, and the electrons passing through this are accelerated, and are made collid with a scintilator 50. A part of the emission secondary electrons 55 collides with the mesh 49, and generates tertiary electrons 57. The tertiary electrons 57 are also accelerated, and are made collid with the scintilator 50, and are made to emit light, and a light emitting signal is introduced into a photomultiplier 52 through optical fiber 51 and a light guide 52, and is amplified, and is converted into an electric signal. In a secondary ion detecting mode, emission secondary ions (positive ion) from the sample 16 are collected in the direction of the mesh 49, and operation is the same with a case of the secondary electron detecting mode. In this constitution, a small device is obtained only by arranging a mesh electrode in the tip vicinity of an SP detector, and the secondary electrons and the secondary ions (positive ion) can be detected, and the work of a fine element can be performed with high

accuracy.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the focused ion beam (Focused Ion Beam, omitting FIB) of detailed components, such as a charged-particle detector in mask loess processing / observation equipment etc., and a semiconductor device.
[0002]
[Description of the Prior Art] The effect of the charge charged by the sample substrate is lost, and the conventional focused ion beam equipment (and omitting FIB equipment) with the source of an electron beam where it is possible to make a desired location carry out incidence of the ion beam is known by JP,5-47934,B. [Focused Ion Beam] This equipment is equipped with the ion source which gives the ion which converges with a lens so that the ion beam which converged minutely may be formed. This ion beam that converged is deflected by the deflecting plate so that it may collide on the front face of a substrate. The low energy electron gun is equipped with the electron source which converges with a lens so that an electron beam may be formed.
[0003] An ion detector detects the ion begun to beat from the front face, and gives a signal to a system computer. When bias of the grid is carried out, an electron and an ion detector detect the electron and ion which were begun to beat from the front face which passes along a grid, and send a signal for a signal to a system computer through an operational amplifier. A system computer connects a grid to the selection potential of the ion or electron given on each terminal of the assignment to which the relay connected to bias control and an arm was controlled, and bias control was equivalent alternatively. The selection potential of a typical electron and ion is within the limits of +300 to +600 volts, and -300 to -2000 volts, respectively.
[0004] Conventionally, with equipment, the electron and the ion detector were more expensive as compared with the electronic detector (it is hereafter called SP detector) which is a channel electron multiplier and consists of a combination configuration of a scintillator (or fluorescent screen) and the photomultiplier tube, and it turned out that there is a fault in which gain tends to deteriorate to long duration use. Moreover, the latter electronic detector is an electronic detector and ion detection cannot be performed.
[0005]
[Problem(s) to be Solved by the Invention] The purpose of this invention is the low price which is the features of SP detector in FIB equipment, and is taking advantage of gain seldom falling to long duration use to make possible not only secondary electron but detection mode of secondary ion (straight polarity). In addition, in order that there may be no spatial tooth space near the point on a sample irradiating [beam] not much, if this detector is not small, either, it will not become.
[0006]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, it was made transpose to the charged-particle detector the electron and both for ion. [which consists of control power supply sections which control the direction and magnitude of electric field between the mesh electrode which

installed the charged-particle detector which detects the emission secondary electron from a sample, and secondary ion (straight polarity) in FIB equipment just before SP detector and this detector and this mesh electrode, and a sample by this invention] A mesh electrode is made to act as an electrode for ion-electronic conversion in cation detection, and it was made to make SP detector detect only an electron especially in [any / of secondary electron and secondary ion (straight polarity)] the case of detection.
[0007]
[Function] With the above-mentioned means, collect in the direction of a mesh electrode, it is made to pass, and the secondary electron from a sample carries out direct detection of this with SP detector. On the other hand, the acceleration impact of the forward secondary ion is collected and carried out to a mesh electrode, it is changed into an electron, and detects this conversion electron with SP detector. Thereby, detection of not only secondary electron but secondary ion is attained.
[0008]
[Example] Hereafter, the example of the charged-particle detector the electron and both for ion is explained using drawing 1 . [of this invention] A metal membrane with a thickness of about 10nm is attached to the front face by the side of the sample of a scintillator (or fluorescent screen) 50, and potential Vs is impressed here from the control power supply section 54. This metal membrane is for preventing electrification by the electron which carries out incidence to a scintillator (or fluorescent screen) 50. Moreover, the metal mesh 49 is placed ahead of a scintillator (or fluorescent screen) 50 (sample side), and potential Vm is impressed to this mesh from the control power supply section 54. A sample is usually held to touch-down potential.
[0009] First, the emission secondary electron 55 from the sample substrate 16 is collected in the mesh 49 direction, accelerates the electron which passed this, and is made to collide with a scintillator (or fluorescent screen) 50 in the case of secondary electron detection mode. Some emission secondary electron 55 collides with a mesh 49, and it generates secondary electron (here, it is called the Miyoshi electron) 57 from a mesh 49. The Miyoshi electron 57 is also accelerated and it is made to collide with a scintillator (or fluorescent screen) 50. The electron of the second place which collided, and Miyoshi makes a scintillator (or fluorescent screen) 50 emit light, through an optical fiber bundle 51 and lightguide 52, this flashing caution signal is led to the photomultiplier tube 53, and is amplified, and it is changed into an electrical signal.
[0010] On the other hand, the emission secondary ion (cation) 56 from a sample 16 is collected in the mesh 49 direction, and it is made to collide with this in the case of secondary ion detection mode. An electron (it is called the Miyoshi electron) 57 is generated from a mesh 49 by this, it accelerates to a scintillator (or fluorescent screen) 50, and this is made to collide with it. The electron which collided makes a scintillator (or fluorescent screen) 50 emit light. The conversion to an electrical signal from future lightwave signals is the same as that of the case in secondary electron detection mode. The potential Vs and the mesh potential Vm of a metal membrane of each detection mode of secondary electron and secondary ion are shown in Table 1. [of the scintillator (or fluorescent screen) of a case] Notice the direction of the electric field of a mesh electrode and a sample about making it reverse in secondary electron and secondary ion (cation) detection mode. The potential of Vs and Vm is controlled from the control power supply section 54. Moreover, although the negative secondary ion of a sample is also detected in secondary electron detection mode, there are very few the amounts compared with the amount of secondary electron, and they can usually be disregarded.
[0011]
[Table 1]

表 1

二次電子および二次イオンの検出モードにおけるシンチレータおよびメッシュの代表的電位

検出モード	電位 [kV]		
	試料	メッシュ(Vm)	シンチレータ(Vs)
二次電子	0	+(0.5～2)	+10
二次イオン(+)	0	−(1～3)	+10

[0012] Next, the example of the FIB equipment incorporating the charged-particle detector electron and both for ion is explained. [this] Drawing 2 is the basic block diagram of the FIB equipment. The ion beam emitted from the liquid metal ion source 100 converges on a sample 200 with a condenser lens 101 and an objective lens 106. Between lenses, the aperture 102, the aligner stigma 103, the blanker 104, and the deflector 105 are arranged. The sample 200 is being fixed on the stage 111 movable in the biaxial (X, Y) direction. The gas which occurred from the source 110 for deposition of gas is drawn near the FIB exposure section by the gas nozzle 108. The secondary electron generated by FIB exposure from the sample 200 on the processing stage 111 is detected by the charged-particle detector 107 an electron and both for ion. XY position signal on CRT of a computer is synchronized with deviation control of an ion beam 1, and a scan ion (SIM) image is displayed on CRT by taking a secondary electron signal on the strength in the brightness (Z signal) of CRT. FIB here is [several 10nm and the beam current of those / 30kV / with Ga beam and a beam diameter] Numbers pA from 10nA extent from about 1 micrometer.

[0013] Moreover, the electron gun for the electrification neutralization for preventing electrification over an insulating material sample is included in this FIB equipment. The potential Ve of the electron gun to a sample is -(100-300) V. There are usually more about single figure amounts of cascade showers from an electron gun than an FIB current. It is in the SIM image observation when using an electron gun, and the detection mode of secondary electron cannot usually be adopted. The reason is for a part of amount of electrons and the amount of the emission secondary electron from the sample by cascade shower exposure to increase considerably compared with the amount of emission secondary electron by FIB exposure from a cascade shower. Therefore, the detection mode of secondary ion is adopted at this time.

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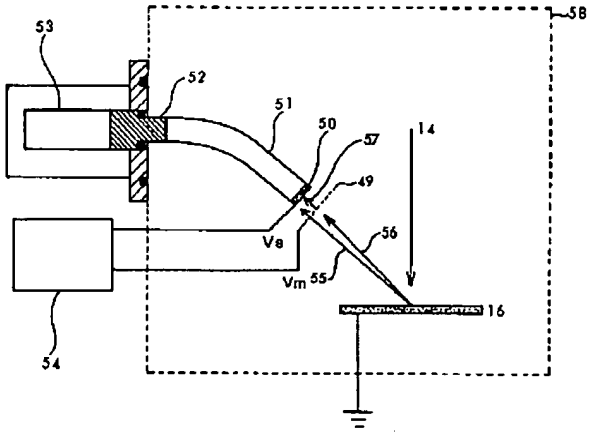
DRAWINGS

[Drawing 1]

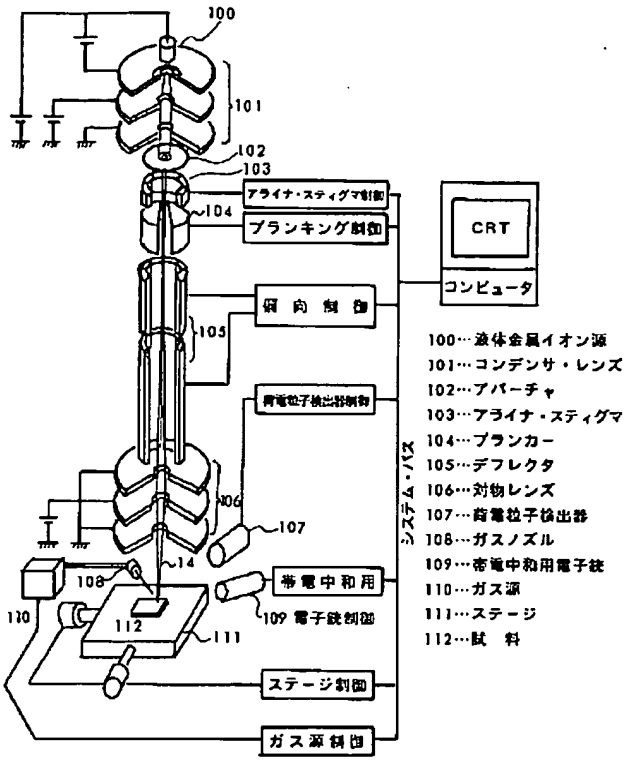
図 1



50…シンチレータ（または蛍光板） 51…光ファイバ束
52…光ガイド 53…光電子増倍管 54…制御電源部
55…二次電子 56…二次イオン 57…三次電子
58…真空領域

[Drawing 2]

図 2



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